UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 33.

[In order to render the results of investigations and experiments conducted by the Agricultural Department of the University of California more quickly and more generally available than has heretofore been done through the annual or biennial reports, it is proposed to embody hereafter, in the form of "Bulletins," to be issued as often as may seem desirable, reports of results, as well as such other discussions, information or answers to questions as may be of general interest. It is intended to make these bulletins, as a rule, short enough for insertion in the daily or weekly papers of the State, and proof-slips of the same will be regularly mailed to papers applying therefor. The substance of these bulletins will ultimately be embodied in a more complete and connected form, in the annual reports of the College of Agriculture.]

Examinations of Soils and Waters.

Soils and Subsoils from Riverside, San Bernardino county; sent by Mr. Geo. L. Waring, of Riverside. Regarding the general character of the soils of the region, Mr. Waring makes the following statements: "The soil here is generally supposed to have been produced by the decomposition of granite, as granite rocks abound in the neighborhood, and small pieces of granite are often turned up by the plow. When wet the soil is of a chocolate color, hard and gritty in character, and when flooded and not subsequently broken up it "bakes" very hard. The stiffer land is rather hard to work and unfriable, but where more sand is present it can be broken up into very small particles. In wet winters alfilerilla grows abundantly, and also a bunch grass with light, bright green leaves, and a small pink flower. Lupins and many other wild flowers also grow. I have noticed milk thistle on cultivated ground. There is a good deal of brush in some places.

"As fruit growing is the main industry here, and as it is carried on by the process of irrigation, the surface soil, except as to its mechanical texture, is of less importance than the subsoil. In the localities where the samples were taken the soil layer is about eight feet deep and then underlaid by sand."

In aspect the several samples sent do not differ very widely, being of a brownish-dun color when dry, with a considerable admixture of angular granite sand and gravel up to buckshot size, and a good deal of shining mica particles. Considering the general aspect and texture of the soils, the amount of coarse sand shown on washing is surprising. The surface soil might mostly be called a coarse sandy loam.

The subsoil is partly light, with much mica, evidently where the sandy layer mentioned intermingles with it; but in most cases it is heavier than the surface soil, and quite stiffish, so that when dry the lumps cannot be crushed with the fingers. When wetted it works quite "heavy," evidently owing to the fact that there is but little fine sand to lighten the clay that binds the coarse particles of granite together.

Of the specimens sent, the surface soil taken to the depth of six inches was not analyzed, but only subsoils. The exact depth to which these were taken are not given by Mr. Waring; of the two analyzed, No. 809 represents the lighter, No. 812 the heavier variety, and probably also, at some points, a higher and lower layer, respectively.

RIVERSIDE SUBSOILS.

	No. 809. Lighter Land.		No. 812. Heavier Land.	
Coarse Sand.....	37.6		26.6	
Fine Earth.....	62.4		73.4	
Insoluble Matter	78.360	83.885	68.34	75.440
Soluble Silica....	5.625		7.10	
Potash.....	.788		.970	
Soda.....	.564		.314	
Lime.....	1.511		1.653	
Magnesia.....	1.240		1.678	
Br. Ox. of Man'ese	.276		.038	
Peroxide of Iron..	3.700		3.641	
Alumina.....	6.676		10.190	
Phosphoric Acid..	.114		.049	
Sulphuric Acid...	.053		.035	
Water & Org. Mat	1.659		2.411	
Total.....	100.462		99.962	
Humus	.115		.188	
Avail. Inorganic .	.314		.388	
Hygrosc. Moisture Absorbed at 14° C.	2.61		5.47	

These analyses fully confirm the suggestion made by Mr. Waring, that the soils of Riverside must be rich in potash; the percentage being very close to that found in the Pomona soils heretofore examined. Lime also is in full supply, yet, on the heavier soil, the application of lime might be made to facilitate tillage, though not requisite for fertilization. In phosphoric acid, curiously enough, the lighter soil exceeds the heavier by more than double, the latter being near the limit of deficiency, while in the lighter the supply is a good one. Both samples examined being sub-soils, it is not surprising that their supply of humus should be small. In the surface soil, doubtless, it would have been found to approximate that found in the soils of Pomona and Redlands (see Report for 1884, P. 56), viz., between three and four tenths of one per cent (.35 p. c.), or about half as much as is desirable in upland soils.

The system of culture should tend to remedy this deficiency, which will doubtless call for the use of Chile saltpeter before many years. In other respects, however, the Riverside soils are evidently quite substantial, and their depth as well as the natural underdrainage by the sandy substratum justifies the claim of their special adaptation to fruit culture.

Marsh soils from near Seminary Park, Alameda county; sent by Mr. Byron Jackson, of San Francisco, with request to ascertain their probable availability when drained. The soils were leached to ascertain the amount of soluble salts therein. This leaching occupied a long time on account of difficult filtration, the solution being of a dark brown tint in both cases. In evaporating the extracts it was noted that there was a sensible giving-off of ammonia; hence a weighed amount of carbonate of soda was added to drive off all the ammonia, and the organic matter was then determined by burning-off from the residue. The following shows the somewhat extraordinary outcome of the examination:

	No. 814. Soil 6 in. depth.	No. 815. Soil 1 to 24 in.
Soil extract, dried at 100°..	37.1%	10.7 %
Organic matter in same.....	6.7%	10.7 %
Ammonia in soil.....	4.7%	not. det'd.

The ignited residue consisted almost wholly of soluble salts, which therefore constitute over 30 per cent of the soil material, No. 814. They contain, besides common salt as the predominant ingredient, a large amount of sulphate of magnesia and some chlorides of magnesium and calcium. The extracts contained in combination respectively:

Chlorine.....	20.1%	13.9%
Sulphuric acid.....	3.5%	3.0%

A more exhaustive examination was not thought necessary, as it appears that the saline ingredients are present in such unusual quantities, and are in part so unusual in kind, as to render the present prospects of profitable reclamation for culture somewhat doubtful. The presence of so large a proportion of ammonia is most unexpected and points to some special source of supply, such as sewers conveying gas water, or other sewage unusually rich in that ingredient. The material as it stands might be used as a source of ammonia for commercial or fertilizing purposes, if in sufficient supply. But it seems hardly credible that such a state of things should extend over any large area.

Water from an artesian well, located on S. 33, T. 25, R. 23, Kern county, about 15 miles southwest of Delano station; sent by Mr. Geo. A. Raymond, of San Francisco. This well is 340 feet deep, bore eight inches in diameter, and has an estimated flow of 1,500,000 gallons per 24 hours.

The water when fresh is colorless and tasteless, very faintly alkaline to test paper.

	Grains per gal.
Total residue after evaporation.....	10.16
Again soluble in water.....	5.02
Insoluble in water.....	2.08
Organic matter and combined water.....	2.45

On heating, the residue blackens considerably and gives off an acid odor.

The soluble part consists in the main of sulphate of soda or Glauber's salt, with some common salt and a little carbonate of soda.

The insoluble part consists in the main of carbonate, with a little sulphate of lime, and little or no magnesia.

It thus appears that the permanently soluble matters in this water exist in usually small proportions for an artesian water, and do not greatly exceed in amount those occurring in Kern river, while less objectionable in quality; there being very little carbonate of soda. This large volume of water may therefore be considered suitable for all practical purposes—irrigation as well as domestic use; and considering its location in a region noted for the extensive prevalence of alkali salts near the surface, this result is both unexpected and important, as it encourages the hope that similarly pure streams may be reached by the auger at other points in the neighborhood.

Water from a well in the Highland Park tract, three miles from Los Angeles post-office; sent by Mr. William Inglis, of that place. This well is 70 feet deep. After passing through six feet of adobe, the auger showed all the rest of the way a sandy gravel, in which the seven-inch piping was finally stopped.

The water, when fresh, has a strong odor of sulphuretted hydrogen. On expelling this gas the water has still a sulphurous taste, proving it to contain an alkaline sulphide in very appreciable quantity.

	Grains per gal.
Total solid residue after evaporation.....	73.7
Again soluble.....	64.4
Insoluble.....	9.3

The soluble portion has a strongly alkaline reaction, and contains chiefly sulphate of soda, or Glauber's salt, with carbonate of soda and common salt; also, when fresh, some hydrosulphide of sodium.

The insoluble part consists of a mixture of the carbonates of lime and magnesia.

While this water is far too strongly mineral for either domestic use or irrigation under ordinary circumstances, it is likely to prove valuable for curative purposes, if the supply should be found adequate; and deserves a closer examination than it is within the province of the station to bestow.

E. W. HILGARD.

Berkeley, Feb. 26, 1885.